

Sadami Matsushita 1920-1984



Sadami Matsushita, of the National Center for Atmospheric Research, died on March 15, 1984, less than a half year after being told that he had stomach cancer. He was born in Kyoto, Japan, on February 12, 1920, the only son of Kiyomi and Taka Taniguchi Matsushita, from whom he acquired his lifelong appreciation of literature and the arts. In 1951,

Matsushita obtained his Doctor of Sciences degree from Kyoto University where, continuing his research and lecturing, he soon became one of Japan's leading experts on the subject of ionospheric processes. In 1954, on an invitation from the Research Staff of Physics at the Imperial College of London, he spent a year in England. Before returning to his homeland, Matsushita was persuaded by Walter Roberts to visit the High Altitude Observatory (HAO) at the University of Colorado at Boulder, Colo. The visit became a permanent 20 years of significant scientific creativity at HAO (which became a part of the Center for Atmospheric Research).

Matsushita's 163 professional publications span 34 years of dedicated research. His specialty was the ionosphere, in particular E region ionization and currents; about two thirds of his publications were concerned with the associated geomagnetic topics. He was an editor of two major textbooks, *Ionospheric Space and Physics of Geomagnetic Phenomena* (Academic Press, New York, 1967). In a review of this later book, E. C. Bullard wrote, "These coming fresh to (geomagnetism) as young men, and their elders who have failed to keep up with current work, will be grateful." Matsushita contributed 17 chapters to various textbooks and encyclopedias. He was continually invited to review ionospheric and geomagnetic topics at international scientific meetings. He was an active leader in the International

Association of Geomagnetism and Aeronomy, the International Scientific Radio Union, the American Geophysical Union, and the Society of Terrestrial Magnetism and Electricity of Japan. He was a fellow of the AAAS, a member of RESA and Sigma Xi, and editor of several scientific journals. For many years Matsushita was the principal organizer of the triennial International Symposium on Equatorial Aeronomy.

To many fellow scientists, Matsushita's greatest contribution was his discussion of the physical processes involved in the ionospheric composition, currents, fields, and motions. As part of his professorial post at the University of Colorado Department of Atmospheric Geophysics, he guided a number of superior graduate students in their dissertations on these topics. Through their research his work continues and grows.

Matsushita's interests extended to Japanese art, music, and history. He was a translator of ancient Japanese writings. At times he advised the Colorado University College of Music concerning their productions involving Japanese costumes, dance, and customs. He enjoyed collecting antique Japanese arrowheads and associated martial artifacts and wrote scholarly articles regarding their classification and historical significance. He was occasionally asked to provide an authoritative appraisal of such items for museum collections. His great joy on weekends at international science conference trips was to discover

a singular Japanese antique at some inconspicuous shop. His home in Boulder was almost a miniature museum for displaying his favorite acquisitions. Indicative of his values and sense of scientific continuity, however, was Matsushita's cherished office adornment: the chair used by Sydney Chapman during his last years at IIAO.

Walter Roberts recalls that Matsushita "was never too busy to give help and, in his critical but gentle way, he would tell me what he thought was right or wrong about the matter I was trying to comprehend." To all of us who knew him, Matsushita was not only a fine and productive scholar but unflinchingly gracious and patient with those who sought knowledge or disagreed with his viewpoint. The world of his friends is now a little more empty with him gone. The world of geophysics has profited greatly by his dedicated lifetime.

Contributions to the tax exempt Matsushita Memorial Fund are being accepted c/o University Corporation for Atmospheric Research, D. A. Reynolds, Comptroller, Box 3000, Boulder, CO 80507. It is the purpose of this fund to publish a bound book of selected Matsushita research papers to distribute to all those who contribute \$10 or more.

This tribute was contributed by Wallace H. Campbell, Branch of Global Seismicity and Geomagnetism, U.S. Geological Survey, Denver, CO 80225.

News

Natural Gas: The Next Shortage

The eighth Annual Meeting of the Gas Research Institute that was held in Chicago in April 1984 focused on the potential of a crisis in the supply of natural gas. According to a report of discussions held at that meeting, "Natural gas, the country's largest petrochemical feedstock, may be in short supply in a couple of years if some present forecasts prove true. The next supply/demand crisis for natural gas is likely to come in early 1986" (*Chemical and Engineering News*, April 30, 1984). There are a number of variables, geologic and socio-economic, that may affect this prediction. An important factor is that drilling exploration of natural gas has decreased sharply, due to the onset of sharp rates of stagnation since 1981. Drilling is highly sensitive to depth and flow rate.

Since 1981, a number of gas wells have been shut down, a process that may have damaged their viability in the future. New drilling has been for relatively shallow holes that could run out of gas in the next 3 years. Future drilling depends a lot on demand, continuation of deregulation, and costs. The natural gas industry was given a number of 6-year lease development awards for deep hole drilling in the Gulf of Mexico. It will take considerable drilling effort to bring these leases into production by 1989, the year they expire. The question now is whether demand will be sufficient to provide the necessary funding.

The reason that a 1986 crisis is predicted by most (but not all) natural gas company executives and market analysts is that supply and demand are expected to balance out by late 1985. Shortages may begin early 1986. The price of natural gas is expected to rise sharply then, owing to shortages and to the phases of deregulation and deregulation of the industry. The status of wells that may have been damaged due to high pumping rates in the past may be a factor in 2 years. The reopening of shut-down wells may be another factor.

The sad outcome of the present circumstances is that not only will gas prices rise in 2 years, but higher prices will support imports again.—PNB

habitat off St. Croix, operated by Fairleigh Dickinson University; the Southeastern Undersea Research Facility (SURF) with a diving bell and surface vessel, operated by universities from Virginia, North and South Carolina, and Georgia; and a University of Hawaii program that uses a small submersible.

Seismologists to Map the Mantle

A. Dziewonski and J. Woodhouse of Harvard University have developed new seismic models of the earth's mantle, according to a recent report. The calculations are the results of attempts to obtain three-dimensional seismic structures of the mantle. The formulations are mathematical but to seismic data, essentially with no major lithological assumptions as to mantle structure. That the model has features that correlate with known crustal and mantle properties has been reassuring. The report quotes Woodhouse, "This makes other patterns discovered in this study highly believable" (*Research and Development*, May 1984). A first finding of the model is related to the homogeneity question of the upper and lower mantle regions. Dziewonski said, "...at this point our maps show little continuity between the upper and lower mantles." Other findings of the new models involve the roots of continental structures, which in South America and Africa extend into the transition zone to depths of about 600 km.

The new models may be limited to previous compilations of the seismic properties of the mantle by Dziewonski and colleagues using the acronym of PREM, etc. In PREM, which refers to the preliminary reference earth model, an attempt was made to develop a parameterized approach and, as in the field of geodesy, compare a reference model in analogy with the reference ellipsoid. The result has been met with broad acceptance. The analogy of attempting to parameterize normalized functions strictly holds true only in terms of seismic coefficients (Vp/Vs), and less so for (Qp/Qs). Radius must be obtained from geodesic models, and density must be fit to models of velocity gradient whose exactness varies, particularly at discontinuities where detailed data may be unavailable (A. M. Dziewonski and D. L. Anderson, *Physics of the Earth and Planetary Interiors*, 25, 1981). Among the revelations of PREM are interpretations that the low velocity zone in the upper mantle is probably due to anisotropy, the result of preferred orientation of mineral crystals (olivine and pyroxene). Thus, the low velocity zone may not be due to a heated zone as previously thought.

Anderson extended the model-making effort recently and called his approach "earth tomography" (See *Eos*, April 17, 1984, cover, and May 8, 1984, p. 346; also see *Science*, 223, 347-355, 1984). He described the analogy with medical practice as follows: "...technique similar to medical tomography being used for imaging, with seismic body and surface waves." There is a departure from the PREM approach in that geochemical reasoning and calculated mineral properties were fed into the modeling procedure. A conclusion was drawn that olivine mineralogy (actually, olivine chemical composition or stoichiometry) was not dominant in the earth as would be the result of having pyroxite model compositions in the mantle. According to Anderson, "The transition region, therefore, appears to be mainly garnetite, rather than olivine and its high pressure forms."

The consequences of this model and of

PREM are that a number of standard assumptions about the earth's interior may be questioned. That the low velocity zone in the upper mantle is not a high-temperature zone could affect thermal models of upper mantle convection mechanisms, and that the 400-km seismic discontinuity is not mainly due to the olivine-spinel transition, and, indeed, may not be a valid discontinuity at all, could be difficult to accept in the context of familiar models of the transition zone. There is essentially no olivine-equivalent component in the transition zone and lower mantle, yielding a permeable lower mantle that would mean that 80% of the earth's volume was made of silicate perovskite.

How are we to know how to interpret Dziewonski and Anderson's models and their soon-expected refinements? Aside from pure reference data (i.e., seismic velocities correlated with the earth's radial distances in three dimensions), the consequences are a (perhaps slight) improvement of interpretation and to the validity of physical properties of mantle minerals calculated over great depths in the mantle. Ground truth for these interpretations lies in extensive seismic data. Ground truth also lies in valid mineral data for the intense conditions of the mantle. The newly emerging field of mineral physics will have to supply this truth.—PNB

Acid Rain Study in Gulf of Mexico

As part of the continuing investigation into the sources and mechanisms of acid rain, a research project sponsored by the National Oceanic and Atmospheric Administration (NOAA) will attempt this summer to find out if natural substances blowing inland from the Gulf of Mexico might be partly responsible for the acidic rain that afflicts the midwestern and eastern United States.

A research team flying a Beechcraft twin-engine airplane will sample air quality at various points offshore, along the Gulf Coast, and inland to measure concentrations of chemicals that are "acid precursors." These precursors—sulfate, sulfur-containing gases, and alkaline materials—form naturally in the Gulf, its estuaries and coastal wetlands, according to the project's principal investigator, Rudolf F. Pueschel of NOAA's Environmental Research Laboratories. The chemicals rise into the atmosphere and are carried inland by onshore winds; the NOAA study group would like to know more about their concentration as they move northward over the continent.

During periods in the summer when stalled high pressure areas in the Gulf and off the Atlantic coast of Florida are forcing air masses inland, the research airplane will fly sampling missions twice daily. The plane is outfitted for trace gas analysis, cloud and rainwater collection, and measurement of aerosol size distribution and elemental composition. The flights will run parallel to the coastline at a distance of roughly 30-50 km offshore, as well as along the coast and at various distances inland (depending on how long the winds blow onshore). Samples will also be taken from within offshore clouds to collect data on how these clouds accumulate chemical compounds from the water.

The flights will originate from points between Corpus Christi and Houston, Tex., and from Mobile, Ala., east across the Florida panhandle. "Selection of these areas [where onshore winds can blow for 2-3 days] followed examination of weather conditions in

the Gulf for the past 5 years," according to Pueschel. The Gulf of Mexico study is part of the National Acid Precitation Assessment Program, a multi-agency investigation of acid rain, and is being conducted by the Air Resources Laboratory, part of NOAA's Environmental Research Laboratories in Boulder, Colo.

In Congress: Upcoming Hearings

The following hearings and markups have been tentatively scheduled for the coming weeks by the House of Representatives. Dates and times should be verified with the committee or subcommittee holding the hearing or markup; all offices on Capitol Hill may be reached by telephoning 302-224-3121. For guidelines on contacting a member of Congress, see *AGU's Guide to Legislative Information and Contact* (Eos, April 17, 1984, p. 159).

June 14: Conference committee on the Export Administration Act reauthorization (S. 970), Capitol Building, Room S-207, 2 P.M.

June 25: Hearing on the National Minerals and Materials Policy Coordination Act (H.R. 3717) by the Mining, Forest Management, and Bonneville Power Administration Subcommittee of the House Interior and Natural Resources Committee, Longworth Building, Room 1324, 9:45 A.M.

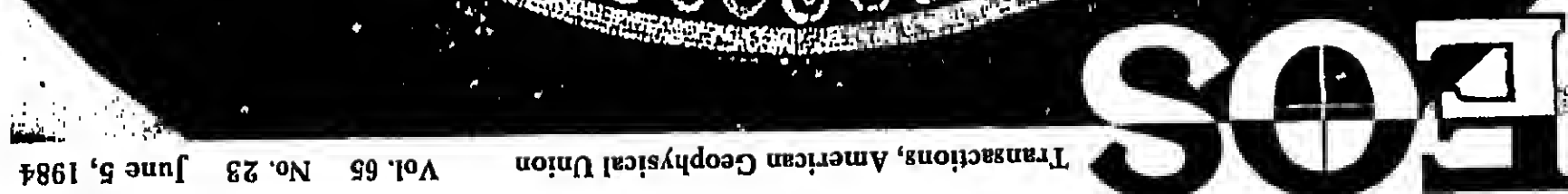
June 26: Hearing on legislation subjecting the Coastal Zone Management Act (P.L. 94-370) to federal consistency provisions (H.R. 4589) by the House Merchant Marine and Fisheries Committee, Longworth Building, Room 1354, date and time tentative.—BTR

Mapping the EEZ

A cooperative, multi-year program to map the largely uncharted Exclusive Economic Zone (EEZ), begun last month, has the potential for piggybacking scientific observations and research. On March 10, 1983, President Ronald Reagan proclaimed the mineral-rich zone as the area between the U.S. shoreline and 200 nautical miles outward. The United States has sovereign rights for exploration, exploitation, conservation, and management of all living and nonliving resources within the zone.

The National Oceanic and Atmospheric Administration (NOAA) and the U.S. Geological Survey (USGS) will cooperate in the project that will map an area nearly twice the area of U.S. land. USGS responsibilities include definition of seafloor geology and definition of geological processes and resources, including sand and gravel, placer, phosphates, manganese nodules, cobalt crusts, and sulfides (Eos, March 20, 1984, p. 105).

NOAA, meanwhile, will be surveying, mapping, analyzing resources, and managing fisheries. Mapping began in the Pacific near Cape Mendocino, Calif. The west coast will be surveyed this year and next, followed by Alaska in 1985, the Hawaiian Islands in 1987, and the trust territories after that. No schedules have yet been set for the east and Gulf coasts. NOAA and the USGS are encouraging the piggybacking of observations and sampling in related areas during the data-gathering cruises. For additional information, contact Adm. John Bossler, National Ocean Service, NOAA, 6001 Executive Blvd., Rockville, MD 20852, or Terry W. Offield, USGS, 915 National Center, Reston, VA 22092.—BTR



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TECHNICAL DIRECTOR NAVAL ENVIRONMENTAL PREDICTION RESEARCH FACILITY

The Naval Environmental Prediction Research Facility (NEPRF), located in Monterey, California, is seeking a highly qualified meteorologist to serve as Technical Director and principal assistant to the Commanding Officer.

NEPRF is the principal Naval activity devoted exclusively to research in meteorology. Its mission is to conduct research and development to provide objective local, regional and global environmental analysis and prediction techniques; and to provide planning, modeling and evaluation services for determining the effect of environmental elements on Naval weapon systems and operations.

The incumbent of this position directs the efforts of the research staff to accomplish the facility's research mission, and he/she serves as a key member of the top planning and management board of the organization.

The incumbent must have a Doctorate Degree in meteorology or a related science, or the equivalent in experience and ability. He/she must also have done internationally recognized individual research, and should have had several years of experience in the direction of the research of others.

This is a Civil Service position at the GS-15 (\$50,252-\$65,327) level. Applicants should contact the address below for information and to obtain the appropriate forms.

Naval Postgraduate School
Civilian Personnel Office (Code 004)
Monterey, California 93943
(408) 646-2001.

Closing date is 15 June 1984. U.S. Citizenship Required.
An Equal Opportunity Employer

Postdoctoral Position/UCLA. Postdoctoral position in experimental geochronology/geochemistry available immediately for research on upper mantle or lower crustal problems. Successful applicant will have a strong background in thermodynamics and petrology. Send application to Art Borchert, Institute of Geophysics and Planetary Physics, University of California, Los Angeles, California 90024, telephone (213) 825-8800.
UCLA is an equal opportunity/affirmative action employer.

Senior or Senior Project Hydrogeologist/Hydrologist. A newly formed hydrogeology and engineering consulting firm, The Mark Group, seeks a mature, experienced hydrogeologist or hydrologist for an immediate filling of a senior technical position in the Las Vegas office. Ongoing and projected investigations will emphasize water resources development, hazardous waste, and geotechnical engineering projects. Principal project work is in California, Nevada, and Arizona. Prefer applicants with minimum ten years similar experience and M.S. degree from a recognized program. Strong written and verbal communication skills and overall initiative are required. Professional registration desirable. Please send resume, references, salary and bonus commensurate with training, experience and productivity. Ownership participation anticipated. Send letter of interest, resume, sample key reports or reprints to:

Dr. Robert F. Kaufman, Principal
The Mark Group
7263 West Coley Avenue
Las Vegas, Nevada 89117

702-471-7128

University of Arizona. The Department of Hydrology and Water Resources invites applications for a faculty position in water resources with emphasis on water policy and management. Candidates must have a doctorate, training and professional experience in water resources and, preferably, in water quality policy and planning. Appointment may be at the level of an assistant, associate, or full professor. Applications should be submitted by October 31, 1984.

Dr. Daniel H. Evans
Chairman, Search Committee
Department of Hydrology and Water Resources
University of Arizona
Tucson, AZ 85721
Telephone: 602-421-3131.

The University of Arizona is an affirmative action equal opportunity employer.

Postdoctoral Research Positions in Planetary Atmospheres/Lunar and Planetary Laboratory, University of Arizona. Applicants are invited to postdoctoral research positions at the Lunar and Planetary Laboratory, University of Arizona, in Tucson, Arizona. The two positions will involve research in planetary physics and analysis of UV data from the Voyager mission. Research opportunities for these positions include the lunar and extended atmospheres and ionospheres of the giant planets and their satellites, the ionosphere of Venus, and the atmosphere and ionosphere of Mars. Applicants should have a strong background in theory and data analysis. Physicists and astronomers are encouraged to apply. Curriculum vitae, bibliography and three letters of reference should be sent by July 15, 1984, to Dr. A. J. Bowdell, Lunar and Planetary Laboratory, University of Arizona, 2521 E. Apt Way, Tucson, Arizona 85721.
The University of Arizona is an Equal Opportunity Employer.

Assistant Research Geophysicist. The Institute of Geophysics and Planetary Physics at the University of California, San Diego, is seeking a highly qualified geophysicist to join an existing research group. The successful candidate should have a Ph.D. in geophysics or related field, and should have experience with land and oceanic EM measurements, a demonstrated capacity to design and construct equipment, and the ability to carry out experiments in the field. The successful candidate should have experience with the analysis and interpretation of EM data. Salary range is \$25,100-\$30,100. Applicants must submit a resume, copies of relevant publications, and the names of three references by July 1984.

Dr. Alan Chave
Institute of Geophysics and Planetary Physics
A-025
La Jolla, CA 92093.
The University of California is an affirmative action equal opportunity employer.

University of Cambridge/Theoretical Seismologist. It is hoped soon to appoint a postgraduate to work independently in the general field of theoretical seismology. An interest in seismic modelling and interpretation, particularly of body waves, would be desirable. Stimulating environment with other theoretical, refractive, reflection and earthquake seismologists. University salary. Send curriculum vitae to Professor C.H. Chapman, Bullard Laboratories, Department of Earth Sciences, University of Cambridge, Madingley Road, Cambridge CB3 0EZ, England, by 31 July 1984.

Marine Organic Geochemist. The Department of Oceanography, Old Dominion University, seeks candidates for a newly created, tenure track assistant professor level position in marine organic geochemistry. Specific research interest is open, although the major departmental emphasis is on coastal processes. The successful candidate is expected to pursue a vigorous funded research program, and to teach graduate and/or undergraduate level courses in his/her field. A Ph.D. is required and postdoctoral experience is desirable. The expanding Oceanography Department offers programs leading to the M.S. and Ph.D. degrees. It currently has 15 faculty positions, with three in chemical oceanography, 70 graduate students, and the appropriate facilities for many chemical studies. The position is available immediately. Applicants should submit a vita, statement of research interest, and the names of three references by August 1, 1984 to: Gregory A. Cutter, Search Chairman, Department of Oceanography, Old Dominion University, Norfolk, VA 23508, 804-442-4285.
Old Dominion University is an affirmative action equal opportunity institution.

Hydrogeologist/Consulting. The Bethesda, MD, office of Dames & Moore has career opportunities available in our expanding hazardous waste management group. We are looking for individuals at the entry level or with 4 to 10 years experience with the following qualifications: 1) Minimum of a B.S. in geology or hydrogeology; 2) Design and review of groundwater sampling and monitoring programs; 3) Groundwater modeling; 4) Analysis of contaminant transport; 5) Field experience; 6) Excellent communication skills. Interested applicants should forward resume to: Dames & Moore, 7100 Wisconsin Avenue, Suite 700, Bethesda, MD 20814. Attn: H.G. Dames & Moore is an equal opportunity employer.

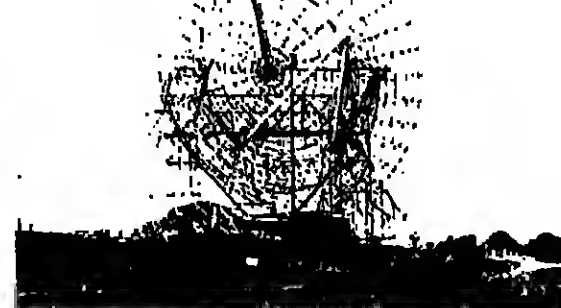
Texas A&M University/Seismic Stratigraphy. The Department of Geology at Texas A&M University has an opening for a Ph.D. with specialization in the field of seismic stratigraphy. This tenure track position is at the assistant professor level. Salary is negotiable depending upon experience and qualifications. This position will be available pending final approval. The successful applicant will be expected to teach undergraduate courses in general geology, a graduate course in seismic stratigraphy, and may develop graduate courses in his/her own design. He or she will also be expected to conduct a vigorous research program.
Applicants should submit a vita along with a letter describing his/her research and teaching goals and the names of five persons, his reference to Professor Robert D. Rehl, Head, Department of Geology, Texas A&M University, College Station, Texas 77843. The closing date for applications is 15 July 1984.
Texas A&M University is an affirmative action equal opportunity employer.

Postdoctoral Research Associate/Physics/Geophysics and Igneous Geochemistry. The University of Maine at Orono (UMO) has postdoctoral openings for a solid earth geophysicist and an igneous geochemist. We seek a geophysicist who wishes to advance fundamental understanding of past and current thermal histories of the Appalachians. The geophysicist would be expected to investigate volcanic and plutonic suites in the Appalachians in Maine and in other terranes. Current funding permits appointments for at least 12 months. Subject to arrival of anticipated funding, the appointments could be extended to two years. Both appointments could start as early as August 1, 1984. Excellent facilities for geophysical research, computer applications, petrologic research and geochemical studies exist at UMO. Additionally, limited funds are available for travel and research, and the appointments will be encouraged to generate external support individually or through cooperation with existing faculty. Please send inquiries, a vita, a list of references, and a description of research interests to Edward R. Decker or Daniel R. Lux, Department of Geological Sciences, 110 Boardman Hall, University of Maine at Orono, Orono, Maine 04469. Telephone calls may be made to 207-581-2152, and forwarded to Decker or Lux.
The University of Maine is an equal opportunity/affirmative action employer.

SPACE SCIENCE AND ASTROPHYSICS

At Stanford University, the Center for Space Science and Astrophysics (CSSA) is an interdepartmental organization coordinating teaching and research in these disciplines. Studies within its purview typically involve ground-based and space-borne experiments, data analysis, theoretical research, computer modeling, and laboratory experiments. Many of these projects involve collaboration with scientists at the NASA Ames Research Center, and in order to facilitate them a joint Institute for Space Research was created by Stanford and Ames in March 1984. Current research activities include:

- Solar physics
- Interstellar matter
- X-ray and EUV astronomy
- Gamma ray astronomy
- Theoretical high-energy and plasma astrophysics
- Gravitation theory
- Cosmology



- Environmental remote sensing
- Space information systems
- Magnetospheric physics
- Space plasma physics
- Celestial mechanics
- Planetary exploration
- Solar-terrestrial relations

RESEARCH FACILITIES

- Stanford Solar Observatory
- Siple Station, Antarctica
- Center for Aeronautics and Space Information Sciences
- Distributed computing facilities

FACULTY

The thirty-six faculty members of CSSA are drawn from the Applied Earth Sciences Department and Geophysics Department in the School of Earth Sciences; the Department of Aeronautics and Astronautics, Electrical Engineering Department and Mechanical Engineering Department in the School of Engineering; and the Applied Physics Department, Chemistry Department and Physics Department in the School of Humanities and Sciences.

COURSE AND DEGREE PROGRAMS

The courses offered in Space Science and Astrophysics include 3 undergraduate courses, 11 courses for advanced undergraduates and graduate students, and 22 courses for graduate students. Graduate study programs for both the M.S. and Ph.D. degrees are available. Details are given in the Stanford University Bulletin, *Courses and Degrees*.

ADMISSIONS

Information regarding admission as either a freshman or a transfer student should be obtained by writing to the Office of Undergraduate Admissions. For information about admission as a graduate student, write to the Office of Graduate Admissions.

FINANCIAL AID

At graduate level, there are opportunities for students in their first year of study to rotate through three different research groups, spending one quarter with each. Research Assistantships, Teaching Assistantships, and Fellowships are available.

NONDISCRIMINATORY POLICY

Stanford University does not discriminate against students on the basis of sex, race, color, handicap, or national and ethnic origin in the administration of its policies and programs.

THE STANFORD ENVIRONMENT

The University is situated on the San Francisco peninsula in the foothills of the Santa Cruz mountains. The location is noted for its mild climate, sunny days, cool nights, and infrequent winter frosts. It is within easy reach of the cultural and recreational opportunities offered by the city of San Francisco, the Pacific Ocean, and the Santa Cruz and Sierra Nevada mountains.

INFORMATION

For further information about CSSA, write to:
Professor R. A. Hewitell, Director
Center for Space Science and Astrophysics
Stanford University
325 Durrant Building
Stanford, California 94305

STANFORD UNIVERSITY

CHIEF LABORATORY FOR ATMOSPHERES NASA/Goddard Space Flight Center Greenbelt, MD 20771

The Goddard Space Flight Center is now recruiting for the position of Chief, Laboratory for Atmospheres. This position includes overall responsibility for management and the intellectual leadership of a broad spectrum of basic research on the atmospheres of the earth and planets with special emphasis on remote sensing from space.

Salary Range: \$58,938-\$69,600

MISSION: The goals of the Laboratory are: (1) to develop and execute a comprehensive theoretical and experimental research program dedicated to advancing our knowledge and understanding of the atmospheres of the Earth and other planets with the aid of space observations, (2) to understand solar, anthropogenic, and natural influences on the atmosphere and related multidisciplinary systems which affect the habitability of the Earth, (3) to diagnose, simulate, and predict environmental conditions empirically and numerically with models and data, and (4) to advance both remote and in situ sensing of the atmospheres of the Earth and other planets and set foundations for future space missions.

The various Branches of the Laboratory specialize in large-scale global modeling and simulation of weather and climate, mesoscale meteorology and severe storms, climate and radiation, the stratosphere, atmospheric chemistry, aeronomy, solar physics, and remote sensing science and instrumentation. The Experimental Climate Forensics Center is a collaborative program with the National Climate Program Office.

STAFF: The Laboratory is comprised of approximately 160 research scientists, engineers, technicians and support personnel who are Federal employees. An additional 100 civil service scientists and support staff from other organizations collaborate with members of the Laboratory on short- and long-term assignments. Approximately 130 additional contract employees work onsite. There are also about 25 post-doctoral research associates who come from universities to work with members of the Laboratory part-time throughout the year.

ADDITIONAL INFORMATION/APPLICATION: Further information concerning this position can be obtained from Dr. David Ains, Laboratory for Atmospheric Sciences, Code 910, Goddard Space Flight Center, Greenbelt, MD 20771. (301) 344-6925. Persons interested in applying for this position should obtain necessary information and application forms from Ms. Beverly Lewoe, Personnel Management Branch, Code 221, Goddard Space Flight Center, Greenbelt, MD 20771. (301) 344-6956. Applications will be accepted no later than July 20, 1984.

EQUAL OPPORTUNITY EMPLOYER

Research Associate/Research Technician. The University of Maine at Orono (UMO) has an opening for a research associate/research technician for a Research Associate position in a small geophysical group. We seek an individual who can use and maintain modern digital electronic equipment; for example, multi-channel analyzers, 10 interfaces for microcomputers, digital plotters and digitizing tablets. Familiarity with BASIC and FORTRAN will be needed, and some geophysical field work may be required as part of the duties of the position. Current funding permits an appointment for at least 12 months. Subject to arrival of anticipated funding, the appointment period could be extended to two years, or longer. Call Edward R. Decker at 207-581-2158 or 207-581-2152 about this position. Candidates send inquiries, a vita and a list of at least three references to Edward R. Decker, Department of Geological Sciences, 110 Boardman Hall, University of Maine at Orono, Orono, ME 04469.
The University of Maine is an equal opportunity/affirmative action employer.

Research Associate/Brown University. Research Associate in Planetary Geology at Brown University, Providence, Rhode Island. Experience in geologic geomorphic analysis of planetary images, study of surface geologic processes, computerized image processing, and/or quantitative geomorphology is desirable. Deadline for applications is June 30, 1984. Submit resume, names and addresses of three references to Dr. James Hearn, Box 1846, Brown University, Providence, RI 02912.
Brown University is an equal opportunity/affirmative action employer.

Research Assistant. Position available immediately for research program: Large-volume high-pressure research, high-pressure X-ray diffraction experiments using the diamond-anvil cell and Brillouin spectroscopy. Candidates should have a background in crystallography and mineral physics with demonstrated ability and experience in single-crystal X-ray diffraction techniques, computer programming, and diamond-anvil cell experiments. M.S. degree or equivalent experience required. Salary: \$16,000-\$18,000 for one year with possible renewal. Send vita and two reference letters to: Professor C. T. Prewitt, Department of Earth and Space Sciences, SUNY Stony Brook, Stony Brook, NY 11794.
SUNY Stony Brook is an affirmative action/equal opportunity employer. AK 118

Research Associate/Postdoc/University of Miami. The Division of Meteorology and Physical Oceanography, Rosenstiel School of Marine and Atmospheric Sciences, University of Miami, searches for a physical data analyst with several years of geophysical data analysis experience for processing and analysis of oceanographic data obtained by moored and shipboard instrumentation. Applicants should be experienced with FORTRAN and preferably also with the VAX/VMS system. Job duties may occasionally include participation in cruises. The successful applicant should have a Masters Degree in physics/mathematical or computer sciences. Application with curriculum vitae and names of three references should be sent to: Dr. Thomas M. Lee, Division of Meteorology and Physical Oceanography, Rosenstiel School of Marine and Atmospheric Sciences, 4600 Rickenbacker Causeway, Miami, Florida 33149, by 16 June 1984.
The University of Miami is a Private, Independent, International Institution.

Research Associate/University of Maryland. The Space Physics Group of the Department of Physics and Astronomy has an opening for a Research Associate beginning as early as July 1, 1984 for an initial one-year period with high likelihood of extension. The position involves research in energetic particles of solar and interplanetary origin. Applicants should possess a Ph.D. in a relevant area of physics or astrophysics; relevant research experience is highly desirable. Inquiries and applications should be directed to Professor Glenn L. Sisco, Department of Physics and Astronomy, University of Maryland, College Park, MD 20742. Applicants should send a vita including complete bibliography and a description of research experience, and should attach the names of at least three letters of reference.
The University of Maryland is an equal opportunity/affirmative action employer.

Hydrogeologist. Applications are invited for a non-tenure track academic research position in hydrogeology to be filled at the instructor or assistant professor level. This position will have broad research responsibilities in one or more of the following areas: regional and site-specific hydrogeological studies; hydrogeological and hydrochemical aspects of surface coal mining and reclamation; and assessment of aquifer characteristics by aquifer testing and hydrochemical evaluation. The position entails considerable field and lab work and will be located in Billings, Montana. Candidates must have a M.S. degree in hydrology or geology (Ph.D. preferred) and at least three years of hydrogeological experience, with emphasis on aquifer testing and related work. Knowledge of drilling and the geology of northeastern Montana preferred. The closing date for applications is June 22, 1984. Salary will be \$24,000-\$29,000/year depending upon education and experience. Applicants with resume and names and telephone numbers of three references should be sent to: Director, Montana Bureau of Mines and Geology, Montana College of Mineral Science and Technology, Butte, MT 59701.
An EEO/AA Employer.

Engineering Positions. (Columbus, Ohio, Location). Battelle, one of the world's leading R&D organizations, has openings in its Office of Nuclear Waste Isolation for engineering staff supporting design and construction activities of the nuclear waste repository. Requirements include degree, preferably advanced, in appropriate discipline and prior experience in nuclear facility or heavy construction. Previous large project, and government experience and P.E. registration preferred. Specific openings are:

- Geochemical/Civil/Mining Engineering (Ref. #115)
- Civil/Mining Engineering (Ref. #116)
- Mining Engineer (Ref. #120)
- Materials Sciences Project Manager (Ref. #048)
- Senior Statistician (Ref. #112)
- Senior Geologist (Ref. #111)

We offer a comprehensive benefits package and an excellent salary commensurate with your background.

If your qualifications are appropriate and you are interested in learning a part of this important program, please send resume, referencing a specific position, to Box 023, American Geophysical Union, 2000 Florida Avenue, N.W., Washington, D.C. 20005.

Battelle
Director Management Division

NATIONAL SCIENCE FOUNDATION (NSF)

NSF's Division of Earth Sciences is seeking qualified applicants for the position of Program Director for the Seismology Program. The position is excepted from the competitive civil service and will be filled on a one- or two-year rotational basis. The salary ranges from \$40,000 to \$86,000 per annum. The program supports basic research in projects related to observational, laboratory, and theoretical studies directed at a thorough understanding of the earthquake process, how seismic waves propagate in the earth, and the determination of earth structure from seismic observations. Applicants should have a Ph.D. in Earth Sciences or equivalent experience, in addition to six to eight years of successful scientific research in seismology beyond the Ph.D. Demonstration of extensive research experience and productivity could be used as equivalence to a Ph.D. A broad general knowledge of geological and geophysical research and familiarity with the U.S. scientific community are also required. Applicants should refer to Announcement No. EX 84-53EOS when submitting resumes to the National Science Foundation, Personnel Administration Branch, Rm. 212, 1800 G Street NW, Washington, DC 20550. Attn: Catherine Handley. For further information call 202/357-7840. Hearing impaired individuals should call: TDD 202/357-7492.

NSF is an Equal Opportunity Employer.

Research Position-Space Physics/Rice University. The Space Physics and Astronomy Department at Rice University seeks applicants for one or more full-time research positions within the department. Successful applicants will play key roles in the development of theoretical three-dimensional models of the Earth's electrodynamics field. Applicants should have knowledge of, and interest in, at least one of the following areas: solar-wind magnetosphere interactions, magnetosphere-ionosphere coupling, ionosphere-atmosphere coupling, collisionless plasma microphysics, atmospheric electricity. Experience and/or interest in numerical modeling is an important consideration.

The and salary level commensurate with experience, ranging from one-year Research Associateship (renewable in subsequent years depending on performance) to one-year Research Scientist appointment in the Center for Space Physics. Please send resume and names of three professional references to: T. W. Hill or R. A. Wolf, Space Physics and Astronomy Dept., Rice University, Houston, TX 77251.
The University is an equal opportunity/affirmative action employer.

Microplateletology/University of Puerto Rico, Mayaguez. Position open July 1, 1984. Assistant Professor level, tenure track, \$17,820 per annum (11 months teaching). Ph.D. required. Duties will include teaching at the graduate level and research in the discipline being emphasized here, supervising student research and conducting personal research. Applicants should send curriculum vitae, a brief statement of teaching and research plans, and letters of recommendation to: Chairman, Appointment Committee, Department of Marine Sciences, University of Puerto Rico, Mayaguez, P.R. 00708. Telephone 809-832-4010, ext. 3443.

Meetings

Announcements

Call for Papers: 31st Pacific NW Regional Meeting

The 31st Pacific Northwest Regional Meeting of the American Geophysical Union will be held September 7-8, 1984, at Oregon State University, Corvallis, Oregon. The convenors are Robert A. Duncan and Shaul Levi. The meeting will comprise a large general session plus special symposia on the first report of *Alvin* submersible diving on the Juan de Fuca Ridge and continental margin of Oregon and Washington, volcanism and plate tectonic evolution of the Pacific Northwest, marine geology, and geophysics.

Deadline for abstracts is August 1, 1984. To submit an abstract, follow the standard AGU format printed in *Eos*, January 10, 1984, p. 18. If you require a sample of the format call the AGU Meetings Department at 202-462-6903. Please send original and two copies to Robert A. Duncan, PNAGU, College of Oceanography, Oregon State University, Corvallis, OR 97331 (telephone: 503-754-2290).

A bargain package for meals and accommodations is available through the university, and the sessions will be held on campus at the Stearns Conference Center.

Two field trips are planned to the Western and High Cascades of central Oregon. The first (September 8) will visit the Western Cascades, and the second (September 9, 10) will transect the Cascade Volcanic Arc from west to east. The cost of the field trips will be minimal, including transportation. Information on field trips and accommodation at the meeting will be provided to each registrant.

Registration for PNAGU is \$15, and the registration deadline is August 15, 1984. For more information please contact Robert Duncan.

Groundwater Modeling Position. Camp Dresser & McKee Inc. has an immediate opening in its Boston (Hillsborough) office for a groundwater modeling engineer. Responsibilities for this position include technical direction and management of projects involving computer modeling of groundwater supply, contamination, and restoration. An M.S. in Hydrogeology or Water Resources and professional registration are required; a Ph.D. is preferred. A minimum of seven years experience in computer modeling of environmental problems with at least three-four years in the groundwater field is required. Extensive field experience would be a definite plus.

CDE is the largest consulting engineering firm specializing in environmental engineering and sciences in the U.S.

For immediate consideration send resume, salary history and requirements to: Camp Dresser & McKee Inc., One Center Plaza, Boston, MA 02108. Attn: Mr. J. J. Vicens.
CDE is an equal opportunity employer.

STUDENT OPPORTUNITIES

Special Doctoral Research Assistantships. The Department of Oceanography of Old Dominion University has several special assistantships available for Fall semester, 1984 and 1985. These carry a stipend of \$7,000 per academic year, renewable for three years. Applicants with M.S. degrees qualify for waiver of tuition. Students interested in obtaining the Ph.D. in the areas of lithology, chemical geology, or physical oceanography should send an introductory resume to: Dr. Donald E. Johnson, Graduate Program Director, Department of Oceanography, Old Dominion University, Norfolk, VA 23508.
Old Dominion University is an affirmative action equal opportunity institution.

Groundwater Conference

July 25-28, 1984 Eastern Regional Groundwater Conference, Newton, Mass. Sponsors: National Water Well Association, Technology Division, (Alice Vickerman, National Water Well Association, 500 W. Wilson Bridge Rd., Worthington, OH 43085; tel.: 614-846-9355.)

The conference will include sessions on groundwater contamination and remedial action; groundwater and contaminant flow through fractured rocks; geophysics applied to groundwater investigation; and two general sessions.

Water Resources Management

July 29-31, 1984 Conference on Educational Prerequisites for Water Resources Management, Baton Rouge, La. Sponsors: Universities Council on Water Resources, (Vivian Haines, Chairman, Systems Engineering Dept., Case Institute of Technology, Case Western Reserve University, Cleveland, OH 44106; tel.: 216-368-4492.)

The program and activities of the conference reflect two major topics: the growing concern over the impacts of the present state of education on water resource management, focusing on the ramifications of recent studies in water resource education focusing on a re-examination of the 1975 annual meeting, which had as its theme "The Challenge of Water Resource Education."

A trip to the Louisiana World Exposition in New Orleans, La., is being planned following the conference.

Moon's Origin

Oct. 13-16, 1984 Conference on the Origin of the Moon, Kona, Hawaii. Sponsors: Lunar and Planetary Institute, Division for

